FTD-TT-63-1054

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TRANSLATION

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FOREIGN TECHNOLOGY DIVISION

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English Pages: 6

SOURCE: Inzhenerno-Fizicheskiy Zhurnal, (Russian), Vol. 6, Nr. 2, 1963, pp 114-117

S/170-63-6-2

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At present time continuous liquid streams are finding greater application in national economy. A tendency can be observed for increasing the rate of their outflow. A hydromonitor is being developed for the breaking up of rocks at a rate of water outflow, exceeding the speed of sould in the air. It is known [1] that a high velocity stream as it gets farther away from the nozzle it expands more and more, acquiring the shape of a cone, consisting of a water/air mixture, whereby its destructive capacity decreases sharply [2]. Consequently, the struggle with atomization of the stream acquires decisive importance in hydromonitors, which are used for the destruction of objects, situated at a considerable distance from the nozzle. It is assumed to be possible to attain compression of the stream with the aid of an outer electric field in case when the stream appears to be electrified. For this purpose at the Institute of High Pressure Physics of the Academy of Sciences USSR was carried out an investigation to determine the effect of electric field on continuous liquid stream. In the experiments were used nozzle adapters with nozzle diameter of from 0.5 to 2 mm. The velocity of the stream in this case was of the order of 2.5 m/sec. To create an electric field was used a high voltage rectifier, with the aid of which it was possible to obtain a voltage of up to 20 kv. Voltage magnitude was determined with the aid of a kilovoltmeter up to 7 kv. and above - by the spark gap in the discharger, situated at the output of the rectifier. The table on which the experiments were carried out was covered with a high voltage rubber cover, so that all objects, situated on the table, were electrically isolated from the ground. Observations were made visually and by photographing with 1/1250 sec exposure. Photographing was done under an angle of 40^o to the plane of stream trajectory, with the objective at the level of the adapter. First of all it was

explained, whether the stream was charged, the stream flowing out from the nozzle into the air. When the stream passes the ring, situated under a potential of + 6 kv, was observed separation of individual water droplets, repeated twisting of same around the rim of the ring and adhesion to same. In another experiment the stream of water was passed vertically downwards between plates of air condenser having on one cover + 6 kv and zero on the other. The stream was first attracted to the plate, having + 6 kv, touching same, and, becoming charged with the plus sign, it was repulsed from that plate and attracted by the zero plate. After this the phenomenon repeated itself from the beginning. The oscillation frequency of the stream depends upon the distance between the plates, magnitude of the potential of positively charged plate, diameter of the nozzle, rate of water outflow and so on. In our case the oscillation frequency per second equalled two. In this way, the stream of water, flowing out from the nozzle into the air, appears to be charged. This is due in all probability to electrokinetic phenomena, but whether electrification takes place in the nozzle or in the air, is difficult to determine.

The authors assumed, that one of the reasons, leading to atomization of the stream as it gets away farther from the nozzle, is the electrification of the stream. The fact is, if water droplets are charged analogously, they are repulsed from each other, increasing the decomposition of the stream. For this purpose were instituted experiments on artificial electrification of the stream. A high voltage wire was connected directly to metal adapters (fig. 1), the stream is charged by the very same sign, as the adapter. To the charged stream is raised a metal rod, fastened on an ebonite handle, and the rod was connected with the aid of a high voltage wire with the adapter. The charged stream was repulsed from such a tester.

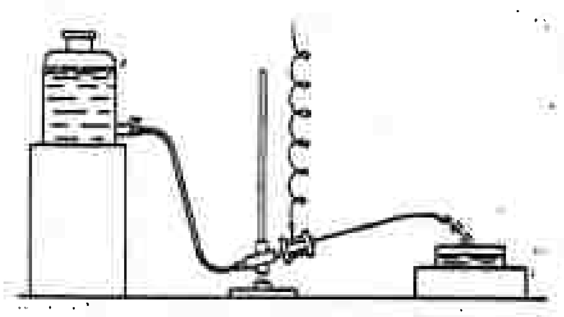

Fig. 1. Artificial electrification of water stream.

Another confirmation of the analogy of stream and adapter charger signs was obtained by directly determining the charges of droplets. Two identical electroscopes were used. One of these was charged with the aid of a metallic pellet on the ebonite handle directly at the nozzle by repeated transfer of identical amount of charges. The second electroscope was charged with the aid of water droplets, flowing out from the nozzle and falling into the sphere of the electroscope. Using different methods both electroscopes, charged to an identical potential, were connected with each other; the electroscope arrows remained in place, which confirmed the analogy of their charges.

GRAPHIC NOT REPRODUCIBLE

a b

Fig. 2. a-stream, flowing out from a double outlet nozzle adapter; b-the very same stream, but the adapter is under very high voltage.

Prepared was a nozzle adapter with two openings, coming out parallel on one side at a distance of 2 mm from each other and a diameter of 0.8 mm. When high voltage is fed to the nozzle adapter these streams were repulsed from each other (fig. 2). It is also evident, that the artificially charged stream decomposes into droplets more intensively, than an uncharged stream. Specially instituted experiments show (fig. 3) that atomization of the stream increases with the rise in applied voltage. At a distance of 350-400 mm from the nozzle the stream begins breaking up and goes into a receptacle in form of individual large droplets. The magnitude of droplet dispersion is proportional to the applied voltage. At a distance of 170-200 mm from the nozzle from the stream break away small streams, consisting of minute water droplets. The angle of stream dispersion rises with the rise in voltage and reaches a maximum value of up to 60°.

It was possible to compress the electrified stream, by running same through a reticulate (for the convenience of observation) metallic cylinder, connected

by a high voltage wire with the nozzle (fig. 4a and b). At a certain critical voltage value of the kinetic energy of the charged stream it appears to be insufficient for overcoming the electric field of the cylinder (fig. 4c).

GRAPHIC NOT REPRODUCIBLE

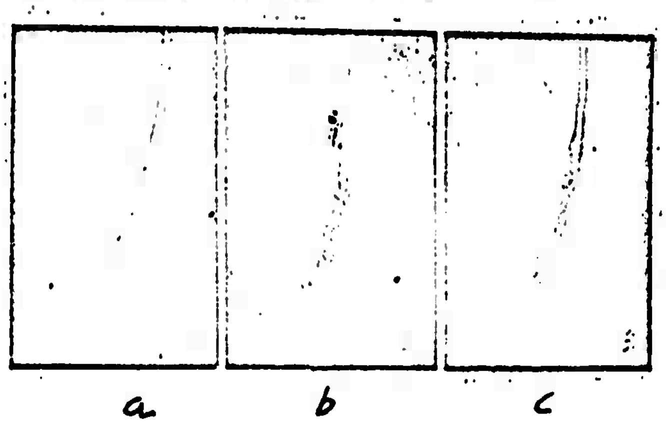

Fig. 3. Increase in stream atomization with increase in applied voltage.

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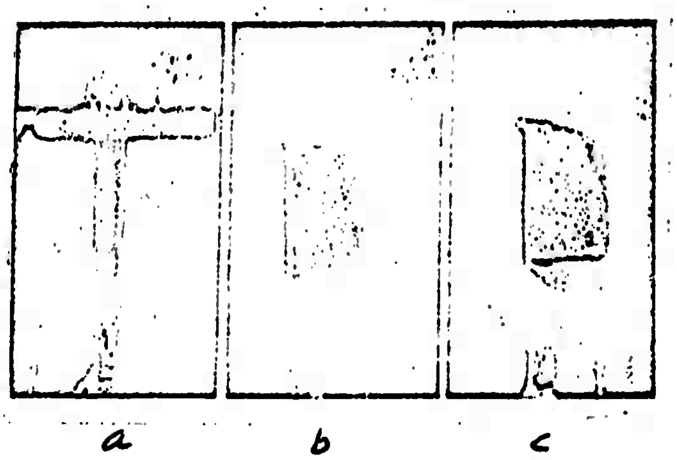

Fig. 4. a-stream, flowing out from the nozzle adapter vertically upwards; b-compression of stream with the aid of an analogously charged cylinder; c-stream cannot "penatrate" through charged cylinder.

All enumerated experiments were carried out with ordinary tap water. Efforts to electrify a stream of kerosene and spindle oil (good dielectrics) yieled no positive results: no potential effect on the form of the stream was observed.

In this way, it was established, that an electrified water stream decomposes proportionally to the potential of the stream. This decomposition can be to a greater extent regulated and reduced to a minimum with the aid of charged focusing cylinders. In any event it can be stated, that if electrification of the stream at the time of its outflow appears to be one of the causes of its decomposition, then the phenomenon of this factor can be reduced to a minimum, by passing the stream through analogously charged cyliders, rings or sylphones.

The experiments allow to hope, that an increase in stream compactness of hydromonitors with the aid of an electric field may be highly effective.

Another confirmation of the analogy of stream and adapter charger signs was obtained by directly determining the charges of droplets. Two identical electroscopes were used. One of these was charged with the aid of a metallic pellet on the ebonite handle directly at the nozzle by repeated transfer of identical amount of charges. The second electroscope was charged with the aid of water droplets, flowing out from the nozzle and falling into the sphere of the electroscope. Using different methods both electroscopes, charged to an identical potential, were connected with each other; the electroscope arrows remained in place, which confirmed the analogy of their charges.

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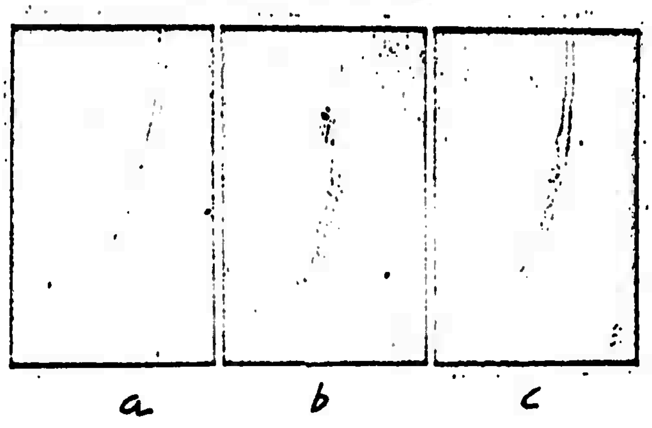

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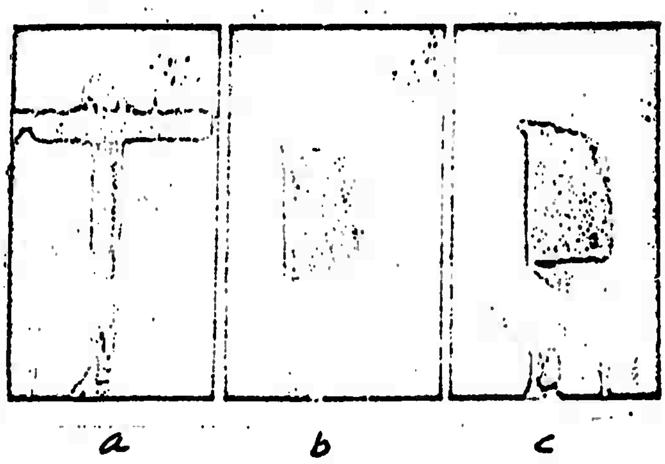

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Summary

The effect of an electrical field on a continous water jet is considered. The higher electrization of water jets, the more intense a jet sprays. It seems possible to contract an electrized water jet by letting it pass the cylinder charged with the same sign. An attempt to electrize kerosene and spindel oil jets (good insulators) was unsuccessful.

Literature

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Submitted June 11, 1962.

Academy of Sciences USSR Inst. of High Pressure Physics, Moscow.

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